

REMARKS

Claims 1-4 are currently pending. Claims 1 and 4 are amended for clarity reasons. New dependent claims 5-8 have been added. Written support for the claim amendments can be found on pages 9-10 of the specification.

The Rejections under 35 U.S.C. § 103

A. Claim 1 stands rejected under 35 U.S.C. § 103 as allegedly obvious over Hagermann (1999). Applicant respectfully traverses the rejections for at least the following reasons.

With respect to claim 1, the Office Action asserts that Hagermann teaches a dithiadicarboxamide used to extract palladium. *See*, Office action at page 2. Further, the Office Action asserts that although the Hagermann structure differs from the instant claims because one R group consists of an H, it would have been obvious to one of ordinary skill in the art at the time of the invention that the structure has the same core as the instant claims and therefore would have the same characteristics. *Id.*

In response, Applicants respectfully submit that Hagermann cited in the Office Action clearly fails to meet the *prima facie* test for obviousness of claim 1 for at least the reasons discussed below. To begin with, Applicants respectfully submit that Hagermann does not teach or suggest all elements of claim 1. Specifically, as acknowledged by the Office Action at page 2, Hagermann does not teach a sulfur-containing tertiary (N-disubstituted) diamide as claimed in structure 1, wherein each of the nitrogen atoms is substituted with two R groups. In contrast, Hagermann only discloses a secondary amide (N-monosubstituted amide), wherein a hydrogen atom is bonded to an amide group. *See* structure in Office Action at page 2 and Hagermann at page 306. Accordingly, Applicants respectfully submit that Hagermann does not teach or suggest sulfur-containing tertiary (N-disubstituted) diamide compounds represented by structure 1 of claim 1.

Moreover, one of skill in the art would not be motivated to create a sulfur-containing tertiary (N-disubstituted) diamide compounds based upon Hagermann because there is no specific reason to do so. For example, Hagermann discloses six different analogues (5a-f) of N-

mono-substituted sulfur-containing amide compounds comprising differing mono substituted R groups. Hagermann, in particular, discloses that *ortho* substituents capable of *hydrogen bonding* with the amide hydrogen are expected to stabilize planar conformations such as that shown for ligand 5f. *See*, Hagermann at page 305. Thus, Hagermann is only focused on retaining the hydrogen atom (H-atom on the amide) to create the so-called “*ortho-effect*” as shown in page 306 to provide planar conformations. Given the special *ortho effect* brought about by the hydrogen atom of the secondary amide in Hagermann’s structures, a person of ordinary skill in the art would not be motivated to select a sulfur-containing tertiary (N-disubstituted) diamide group, wherein the hydrogen atom is lost to an R group thereby eliminating the *ortho effect*. Hagermann therefore teaches away from modifying the mono-substituted sulfur-containing amide compound such as to create a sulfur-containing tertiary (N-disubstituted) diamide group because this modification would not provide the desirable hydrogen bonding for creating the “*ortho effect*” and planar conformation as desired by Hagermann.

Additionally, Applicants respectfully submit that the use of sulfur-containing tertiary (N-disubstituted) diamide compounds as claimed in structure 1 *unexpectedly* led to greater selectivity and affinity for palladium extraction in comparison with previously disclosed Di-N-hexyl sulfide (DHS), a sulfur-containing compounds used in metal extraction process. For instance, Example 1 and Table 1 in the specification illustrate that the use of various sulfur-containing tertiary (N-disubstituted) diamide compounds represented by structure 1 led to a greater than 99% extraction of palladium as compared to other metals such as Pt, Rh, Cu, Fe and Zn. *See*, specification at page 16. This greater affinity for palladium is attributed to the sulfur-containing tertiary (N-disubstituted) diamide group structure as opposed to the secondary (N-monosubstituted) group represented by Hagermann, wherein the nitrogen atom of the secondary amide can coordinate to some metal ions thereby reducing its selectivity for palladium (Pd). Thus, routine experimentation by one of skill in the art cannot be used as motivation to experiment and optimize Hagermann’s structure to enhance its selectivity for palladium because there is no reason from Hagermann’s disclosure to do so. Accordingly, Applicants have achieved unexpected and surprising selectivity and efficiency in extracting palladium using the structure of claim 1.

Applicants also believe that Hagermann's structures have lower hydrophobicity than the sulfur containing tertiary (N-disubstituted) diamide structure represented in claim 1 thereby leading to increased loss of metals into the aqueous phase during the extraction process, which is not desirable for industrial applications. Therefore, the sulfur containing tertiary (N-disubstituted) diamide structure of claim 1 overcomes various deficiencies of the prior art structures such as that disclosed by Hagermann by providing considerable efficiency in speed of extraction as disclosed in page 15 second paragraph of the specification, and improvement in affinity for palladium extraction for industrial applications. For all of these reasons discussed above, claim 1 is not obvious over Hagermann and Applicants respectfully request withdrawal of this rejection.

B. Claim 2 stands rejected under 35 U.S.C. § 103 as being obvious over Singh (20030190274) in view of Hagermann (1999). Applicants respectfully traverse the rejections for at least the following reasons.

With respect to claim 2, the Office Action asserts that Singh teaches a method of extracting palladium or other metal anion complexes that comprises contacting an aqueous solution with an organic solution including a diquaternary amine, selectively binding the metal ion complex to the diquaternary amine and then separating the organic solution from the aqueous solution wherein the diquaternary amines having the selectively bound metal anions are concentrated in the organic solution. *See*, Office Action at page 3. Further, the Office action states that it would have been obvious to substitute the dithiocarboxamide as taught by Hagermann in for the diquaternary amine taught by Singh because a sulfur-containing diamide results in a more highly selective separation and a higher recovery efficiency of palladium. *Id.*

In response, Applicants respectfully submit that claim 2 depends from claim 1, which incorporates structure 1. As indicated by the foregoing in section A, Applicants consider independent claim 1 to define subject matter that is unobvious over Hagermann. Singh fails to cure the deficiencies of Hagermann, it does not disclose or suggest a sulfur-containing tertiary (N-disubstituted) diamide structure represented in claim 1. Singh only discloses a diquaternary amine as the organic phase to extract platinum group metals, it does not teach or suggest

substituting the diquatary amine for the dithiacarboxamide structure of claim 1. Therefore, Hagermann and Singh do not teach or suggest, alone or in combination, all of the elements of independent claim 1. Accordingly, Applicants request withdrawal of this rejection as to dependent 2.

C. Claim 3 stands rejected under 35 U.S.C. § 103 as being obvious over Singh in view of Hagermann as applied to claim 2 and further in view of Alizadeh. Applicant respectfully traverses the rejections for at least the following reasons.

With respect to claim 3, the Office Action asserts that Singh and Hagermann disclose a method for extracting palladium using sulfur-containing diamides, but that neither teaches a back extraction using HCl and thiourea. *See*, Office Action at page 3. Further the Office Action asserts that Alizadeh, in table 1, teaches using HCl and thiourea as stripping agent on the recovery of palladium and that it would have been obvious to one of ordinary skill in the art to use HCl and thiourea because these are conventional stripping agents that result in high level of recovery of palladium. *See*, Office action at pages 3-4.

In response, Applicants respectfully submit that claim 3 depends from claim 2, which in turn depends from claim 1 and incorporates structure 1. As indicated by the foregoing in section A, Applicants consider independent claim 1 to define subject matter that is novel and unobvious over Hagermann. Similarly, Singh fails to cure the deficiencies of Hagermann, it does not disclose or suggest a sulfur-containing tertiary (N-disubstituted) diamide structure represented in claim 1. Singh only discloses a diquatary amine as the organic phase to extract platinum group metals, it does not teach or suggest substituting the diquatary amine for the dithiacarboxamide structure of claim 1. Additionally, Alizadeh does not remedy the deficiencies of Hagermann and Singh because Alizadeh also fails to teach a sulfur-containing tertiary (N-disubstituted) diamide structure as shown in claim 1. While the process of back-extraction may be routine, the use of this process with the novel structure of claim 1 is not obvious. Therefore, Hagermann, Singh and Alizadeh do not teach or suggest, alone or in combination, all of the elements of independent claim 1. Accordingly, Applicants request withdrawal of this rejection as to dependent 3.

D. Claim 4 stands rejected under 35 U.S.C. § 103 as being obvious over Singh in view of Hagermann in view of Alizadeh as applied to claim 3 and further in view of Farone *et al.* (U.S. 20020112569) and Lea *et al.* U.S. 4,390,366.

With respect to claim 4, the Office Action asserts that Singh, Hagermann and Alizadeh teach a method for extracting palladium using sulfur-containing diamides and stripping with HCl and thiourea (second and third step), and that Farone teaches a method of recovery of precious metals from low concentration sources along with neutralization of the liquid generating base metal precipitates as hydroxides. *See*, Office Action at page 4. Further, the Office Action states that Lea teaches a process for the extraction of precious metals from solutions using TBP with a chlorinated diluent. *Id.* The Office Action further asserts that it would have been obvious to one of ordinary skill in the art to incorporate the extraction step as taught by Lea in to the method as taught by Singh, Hagermann, Alizadeh and Farone because the Lea step is an efficient way to recover platinum in a solution while the rhodium remains dissolved in the solution. *See*, Office Action at pages 4-5.

In response, Applicants respectfully submit that claim 4 depends from claim 1, which incorporates the structure 1. As indicated by the foregoing in section A, Applicants consider independent claim 1 to define subject matter that is unobvious over Hagermann. Similarly, Singh fails to teach or suggest, alone or in combination with Hagermann, a sulfur-containing tertiary (N-disubstituted) diamide structure represented in claim 1. Singh does not teach or suggest substituting the diquaternary amine for the dithiacarboxamide structure of claim 1. Additionally, Alizadeh does not remedy the deficiencies of Hagermann and Singh because Alizadeh also fails to teach a sulfur-containing tertiary (N-disubstituted) diamide structure as shown in claim 1. Also, Farone and Lea do not remedy the deficiencies of Hagermann, Alizadeh and Singh because they do not teach or suggest, alone or in combination, all of the elements of independent claim 1, in particular the sulfur-containing tertiary (N-disubstituted) diamide compound. While the step of neutralization and use of TBP may be routine in extraction of metals, the use of this process with the novel structure of claim 1 is not obvious. Accordingly, Applicants request withdrawal of this rejection as to dependent claim 4.

E. New Claims 5-8

New claims 5-8 have been added by this Amendment, which depend from independent claim 1. None of the references cited above, *i.e.*, Hagermann, Singh, Alizadeh, Farone, and Lea alone or in combination, teach or suggest all the limitations of these claims. These claims further recite the specific type of R groups on the sulfur-containing tertiary (N-disubstituted) diamide structure of 1. Hagermann does not teach or suggest these specific R groups. In view of these distinctions, Applicants submit that all these claims are in condition for allowance.

In view of the foregoing, Applicant respectfully requests reconsideration and the timely allowance of the pending claims. Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicant's undersigned representative to expedite prosecution.

If there are any other fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-0310. If a fee is required for an extension of time under 37 C.F.R. § 1.136 not accounted for above, such an extension is requested and the fee should also be charged to our Deposit Account.

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Respectfully submitted,
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